Digital Equipment Corporation
Maynard, Massachusetts

digital

Maintenance Manual

PC04/PC05 PAPER-TAPE READER/PUNCH

(FEED-HOLE STROBED MODELS)

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PC04/PC05
PAPER-TAPE READER/PUNCH
(FEED-HOLE STROBED MODELS)

This manual pertains only to those PC04 or PC05 models that strobe the data by the signal derived from the feed holes. This method is provided when ECO number PC04-00046 or PC05-00021 is implemented on the corresponding PC04 or PC05 unit. When the unit is not implemented with the above ECO, refer instead to the corresponding maintenance manual:

PC04 (Document Number DEC-00-HGPA-D) or
PC05 (Document Number DEC-00-HGHA-D).

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS

1st Edition, August 1970
2nd Printing (Rev) June 1971
3rd Printing October 1972
4th Printing December 1972

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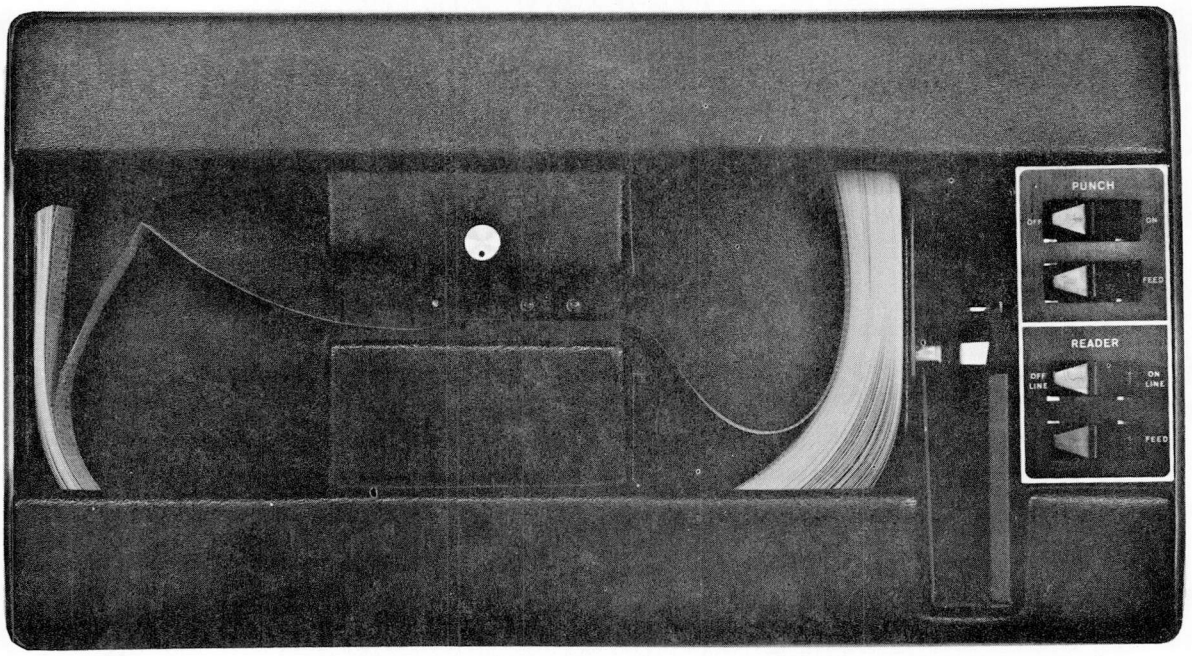
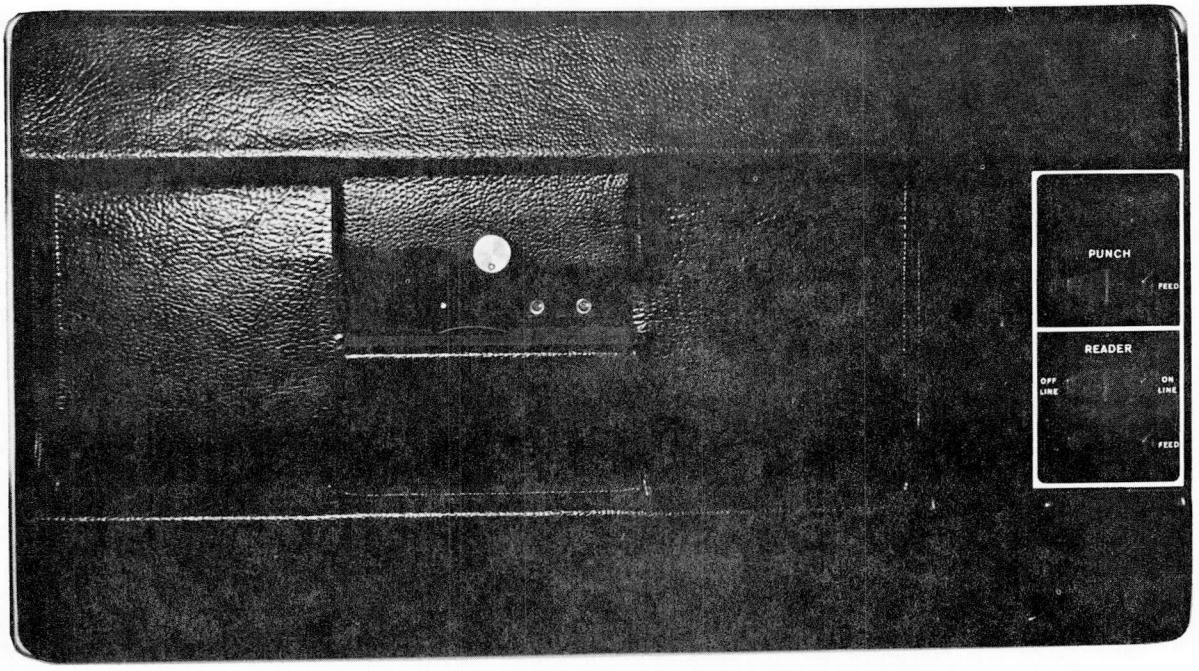


PC04 High-Speed Reader/Punch



PC05 High-Speed Reader/Punch

CHAPTER 1
GENERAL INFORMATION

1.1 SCOPE

This manual contains maintenance information for both the PC04 and PC05 High-Speed Paper-Tape Readers and Punches (feed-hole strobed models only) manufactured by Digital Equipment Corporation (DEC). The earlier versions of the PC04 and PC05 models, which do not strobe the data by the signal derived from the feed holes, are described in the following maintenance manuals: *PC04 Maintenance Manual,* DEC-00-HGPA-D and *PC05 Maintenance Manual,* DEC-00-HGHA-D.

The PC04 is currently used with the PDP-8E, PDP-8I, and PDP-8L computer systems, and the PC05 is used with the PDP-11, PDP-12, and PDP-15 computer systems. Each computer system has its own unique interface and control characteristics; consequently, this manual discusses only the electrical and mechanical operations of the basic reader and punch and considers the computer an external piece of equipment.

1.2 GENERAL DESCRIPTION

The PC04/PC05 High-Speed Reader and Punch is supplied as an option to the various computer systems and is available in the configurations listed in Table 1-1.

Table 1-1
PC04/PC05 Configurations

Description	PC04 (Used with PDP-8I)	PC04 (Used with PDP-8E and 8L)	PC05 (Used with PDP-11, 12, and 15)
Reader Only	PC04R	PC04RB	PC05R
Punch Only	PC04P, PA*	PC04PL, PM*	PC05P, PA*
Reader and Punch	PC04BB, BC*	PC04BL, BM*	PC05C, CA*

*These designations indicate 50 Hz models. The 50 and 60 Hz models are identical, with the exception of the punch pulley.

The PC05 contains its own power supply and control and drive circuitry, while the control circuitry for the PC04 is contained in the CPU.

The tape reader mechanism is manufactured by DEC and contains an electromechanical tape-feed system, with associated current drivers, and a nine-channel photoelectric tape-read head, including photocell amplifiers. Information is read from 8-level, 1-inch perforated tape, at a maximum rate of 300 characters per second or at a single character rate of 20 characters per second.

The tape punch mechanism is a Roytron Model 500 modified by DEC. Contained in the unit is an electromechanical tape feed and punch system capable of punching five-, seven-, or eight-level tape. In addition, an SCR Driver is included on the PC05 that switches the ac power to the punch motor after a command to punch is received.

1.3 FUNCTIONAL DESCRIPTION

1.3.1 Reader

A functional block diagram of the tape reader is shown in Figure 1-1. The read head, located below the tape, contains nine photocells; eight for sensing data and one for sensing the feed hole.

The light source is located directly above the tape channel and read head. As the tape passes over the read head, each photocell senses the presence (a hole) or absence (no hole) of light. When a hole is detected, that photocell is activated and feeds an individual photoamplifier. The output of the photoamplifier is sent to the M7050 Reader Control Module, which temporarily stores the eight data bits in a buffer and then signals the central processor that data is available. The central processor responds with a command that strobes the data (RD holes 1 through 8) into the central processor via the Input-Output Bus lines.

The reader FEED switch, when pressed, enables the reader control, which advances the tape through the read head without actually reading.

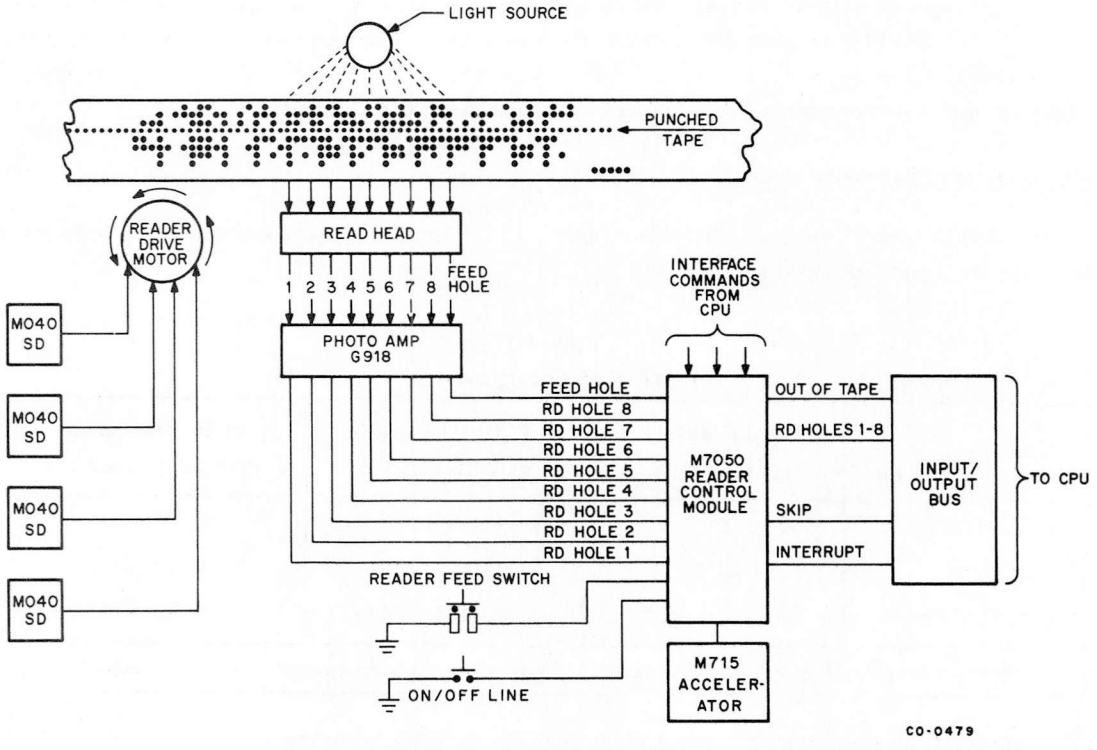


Figure 1-1 Reader Functional Block Diagram

Tape is advanced through the read station in a stepping motion by a sprocket wheel connected to the shaft of the reader drive motor. The M040 Solenoid Driver Modules provide drive current to the two center-tapped motor windings in turn. As each half of a winding is activated, the motor and, hence, the sprocket wheel rotate to pull the tape through the read station.

1.3.2 Punch

The punch unit performs three basic operations: it moves the paper tape, positions the tape, and punches the tape. Moving, positioning, and punching of paper tape all occur during one rotation of the punch mainshaft.

A functional block diagram of the punch is shown in Figure 1-2. A punch command and the data to be punched are sent from the respective central processor and are stored in the M710 Punch Control Module†. When it has been determined that the punch mainshaft is at the beginning of a punch cycle, the M710 activates the M044 Solenoid Interposer Drivers which, in turn, initiate operation of the punch pins. The M710 then signals the central processor that another punch command may be initiated.

The punch drive motor, which advances the tape through the punch block, is controlled by the SCR Driver in the PC05 and a switch in the PC04. The object of the SCR is to run the motor only when punching to eliminate unnecessary noise and wear. There are two ways of enabling the SCR Driver:

a. A punch command from the CPU.

b. Pressing the PUNCH FEED switch (overrides a punch command from the CPU).

The motor requires 0.4 sec to reach full speed, at which time the punch command is executed. A timer in the punch circuitry allows the motor to run for 5 sec after the last punch command, in the event more punching is to occur.

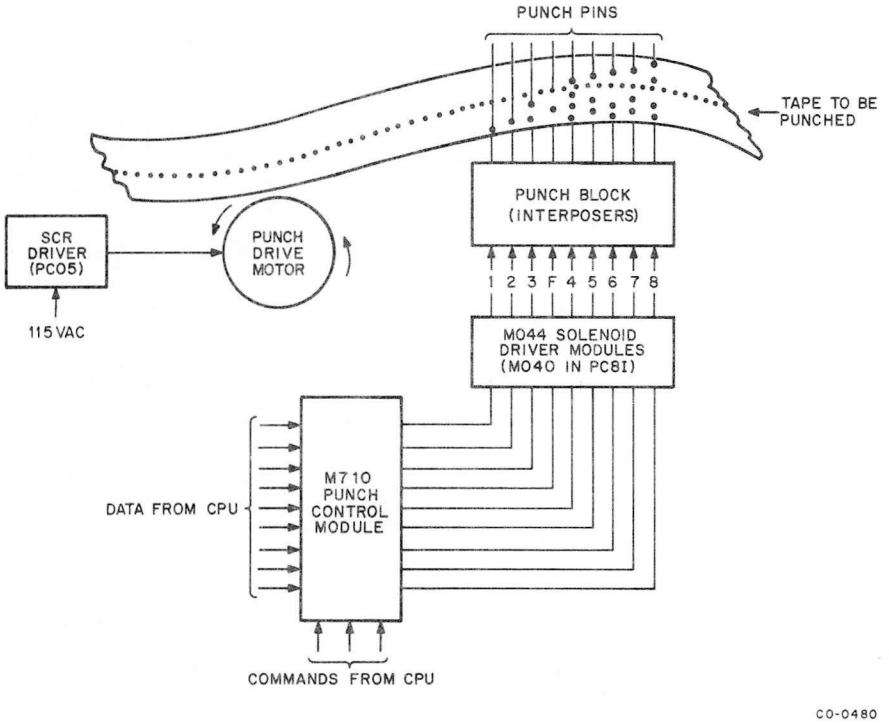


Figure 1-2 Punch Functional Block Diagram

1.4 SPECIFICATIONS

Table 1-2 lists the mechanical, electrical, and environmental specifications for the PC04 and PC05 Reader/Punch.

†The PC8E incorporates the M7050 (Reader Control), the M715 (Reader Accelerator), and the M710 (Punch Control) functions on one module: the M840. Otherwise operation is identical.

Table 1-2
PC04/PC05 Specifications

Specification	Description
Physical dimensions	Height: 10.5 in. Width: 19 in. Depth: 15 in.
Tape characteristics	Reader: Gray, unoiled, fan-folded** Punch: Oiled or unoiled, fan-folded
Tape tension (in punch)	6 oz, maximum
Power requirements	115 Vac ±10%, 50 or 60 Hz
Power supplies (internal)	Regulated, -15V ± 1V Regulated, +5V ± 0.25V Unregulated, -36V ± 4V
Logic levels	Logic 1 (H): +2.0V, input +2.4V, output Logic 0 (L): +0.8V, input +0.4V, output
Temperature (Operating)	Reader: 55° to 110°F Punch: 55° to 110°F
Temperature (Nonoperating)	Reader: 10° to 150°F Punch: 10° to 150°F
Humidity* (Operating)	Reader: 20 to 95% (w/o condensation) Punch: 20 to 95% (w/o condensation)
Humidity (Nonoperating)	Reader: 5 to 95% (w/o condensation) Punch: 5 to 95% (w/o condensation)

*The humidity specifications are for the reader/punch mechanism. Paper-tape manufacturers' recommendations for operating environment should be followed. Suppliers of paper tape include Digital Equipment Corporation and Carter Rice Storrs and Bement.

**Tape of up to 12% transmittance may be used. Consult DEC for operation of reader with more transparent tape.

CHAPTER 2
INSTALLATION

2.1 INSPECTION

On receipt of the equipment, inspect it for any visible signs of damage in transit, such as dents or abrasions. Inspect the logic modules for any foreign material that may have lodged in them during shipment. Any damage observed should be reported immediately to both the carrier and DEC. Check the contents of the carton with the shipping document and report any omissions immediately to DEC. Installation is not recommended until all materials are in hand.

2.2 INSTALLATION

2.2.1 Mounting

As previously noted, the PC04/PC05 is used with different computer systems, and therefore a specific mounting procedure cannot be included in this manual. The unit is normally mounted in the central processor cabinet above the control panel. It can, however, be mounted in an accessory cabinet.

2.2.2 Connections

Refer to Figure 2-1 for PCO connections and Table 2-1 for CPU or BA connections.

Table 2-1
CPU and BA Connections

	PDP-8E	PDP-8I	PDP-8L
PC04	Reader Cable → M840 Punch Cable → M840 M840 → Omnibus	Reader Cable → D01 Punch Cable → C01 M040 → C02–C06 M7050 → HJ26 M710 → HJ28 M715 → HJ27	Reader Cable → C34 Punch Cable → C34 M7050 → AB30 M710 → AB32 M715 → AB29
	PDP-11	**BA12**	**BA15**
PC05	Reader Cable → M781 Punch Cable → M781 M105 → E13 or E14 M781 → CD13 or CD14 M782 → F13 or F14	Reader Cable → D06 Punch Cable → D07 M119 → B06	Reader Cable → B28 Punch Cable → B13 M103 → B15 M104 → B10 M311 → A28 M606 → B14 M776 → AB22

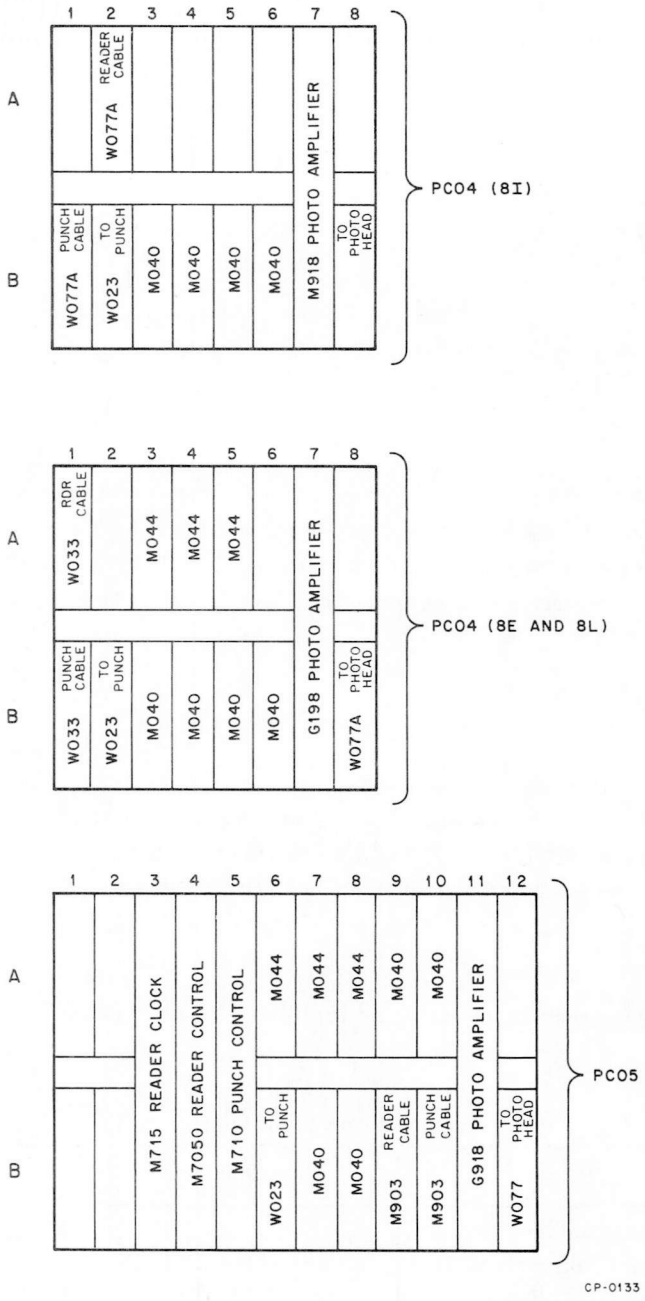


Figure 2-1 PC04/PC05 Module Locations

2.2.3 Module Configurations

Because the reader and punch are available in many configurations, the quantity and type of modules vary. Table 2-2 lists the modules required for each configuration.

Table 2-2
Module Configurations

Unit	Module	Description	Reader & Punch	Reader Only	Punch Only
PC04	G918	Photo Amplifier	1	1	0
(PC8E and	M040	Solenoid Driver	4	4	0
PC8L)	M044	Solenoid Driver	3	0	3
PC04	G918	Photo Amplifier	1	1	0
(PC8I)	M040	Solenoid Driver	4	4	0
PC05	G918	Photo Amplifier	1	1	0
	M040	Solenoid Driver	4	4	0
	M044	Solenoid Driver	3	0	3
	M7050	Reader Control	1	1	0
	M710	Punch Control	1	0	1
	M715	Reader Clock	1	1	0

2.3 POWER REQUIREMENTS

The 3-terminal, 110-Vac power connectors (P1 and P2), located at the rear of the chassis, provide both an input and an output point for primary power. The connectors, one male and one female, permit the inclusion of the PC04/PC05 in a power chain with other system devices.

Power and signal connections are made in accordance with the procedures given in the applicable DEC interface, installation, or maintenance manual.

2.4 CHECKOUT

When the PC04/PC05 has been installed, proceed as follows to checkout the unit.

Step	Procedure
1	Apply power to the computer system and turn on the punch and reader.
2	Load a new carton of tape in the punch tape well, located at the rear of the chassis, and feed the tape through the punch unit (refer to Paragraph 3.3.1).
3	Press the punch FEED switch on the front panel. Tape should feed out of the tape slot and should be unpunched except for feed holes.
4	Hold the punch FEED switch on until a few feet of tape have been punched. Tear off the tape and insert it in the reader head, feeding from left to right.
5	Press the reader FEED switch and observe that the tape feeds evenly without binding on the edges of the tape guide.
6	Load and run the applicable MAINDEC diagnostic test (listed in Appendix A), using the instructions contained with the diagnostic test. If any errors occur, refer to Chapter 5 of this manual.

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This chapter contains information on the PC04/PC05 controls, and loading of tape. All programming is done via the computer. Refer to the respective user's guide or maintenance manual for this programming information.

3.2 CONTROLS AND FUSES

The controls and fuses for the PC04/PC05 are listed in Table 3-1.

Table 3-1
PC04/PC05 Controls and Fuses

Nomenclature	Function
PUNCH ON/OFF (SW) (PC04)	Applies power to punch motor.
PUNCH FEED (SW)	Punches leader tape.
READER ON-LINE/OFF-LINE (SW)	Allows or disallows reading of tape (on-line).
READER FEED (SW)	Manually feeds tape through read station.
F1 3A, SB	Fuses the ac power to the unit.
F2 4A	Fuses the +5V regulated power input.
F3 1A	Fuses the -15V regulated power input.
UNIT ON/OFF (SW)	Switches ac power into the unit.

3.3 OPERATING INSTRUCTIONS

For routine operation of the PC04/PC05, refer to Table 3-1, which describes controls and fuses. Tape loading procedures are given below.

3.3.1 Loading Blank Tape (refer to Figure 3-1)

To load blank tape for punching, proceed as follows:

Step	Procedure
1	Pull the unit straight out of the rack on its drawer slides, then flex the tape-feed bracket and remove and discard the exhausted tape supply carton.
2	Press the FEED button on the tape punch until the stub end of tape stops moving out of the machine.

(continued on next page)

Step	Procedure
3	Pull the stub out of the exit slot.
4	Install a carton of tape in the tape well provided on the rear of the tape punch chassis.

NOTE

Under certain conditions, such as low humidity, chad tends to build-up in the plastic punch cover and subsequently the punch assembly. This condition can be avoided by dipping the plastic punch cover in an antistatic solution.

5	Feed the new tape out of the carton, with the printing face down. Route the tape through the two rollers, over the out-of-tape switch and guide plate, directly into the punch block (see Figure 3-1).
6	Guide the tape out over the sprocket and down through the feed-chute tray.
7	Press and hold the PUNCH FEED switch until several folds of tape are present in the bin. It is necessary to stack the first few folds by hand to guarantee proper stacking.
8	It is good practice to empty the chad box whenever a new box of tape is loaded.
9	The punch should be oiled monthly by running a box of oiled tape through it while punching all 1s.

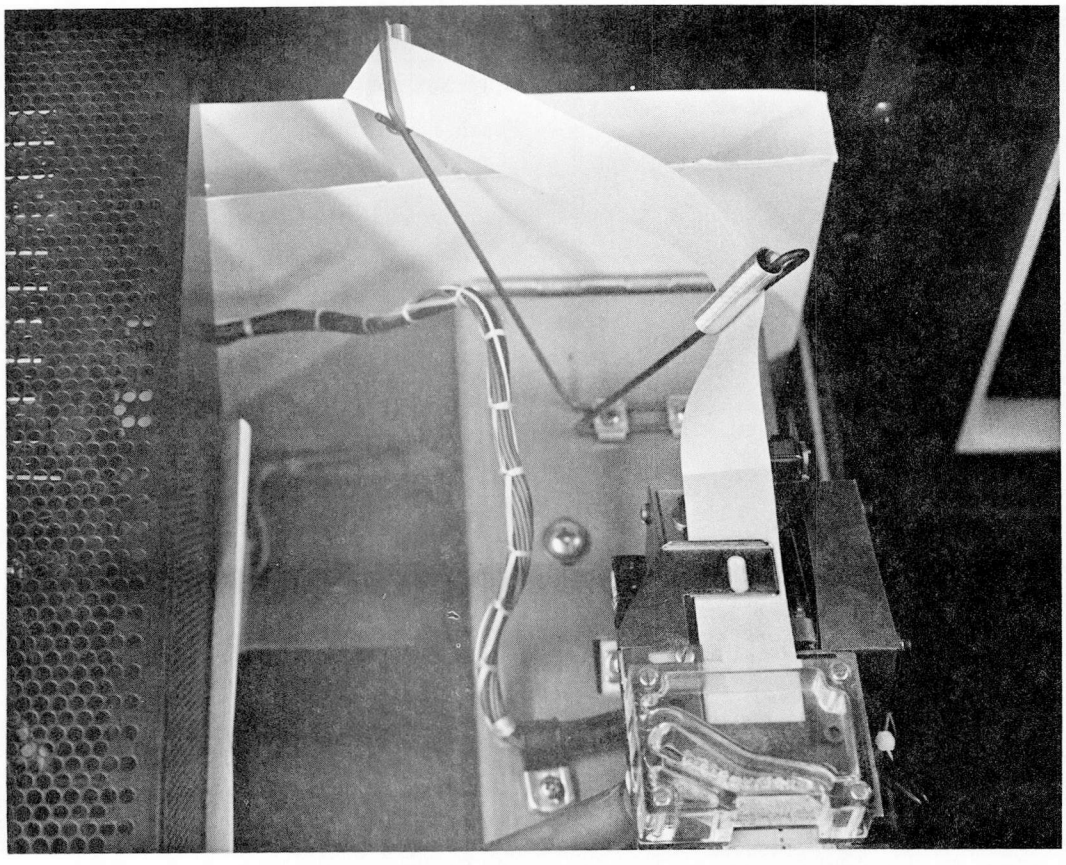
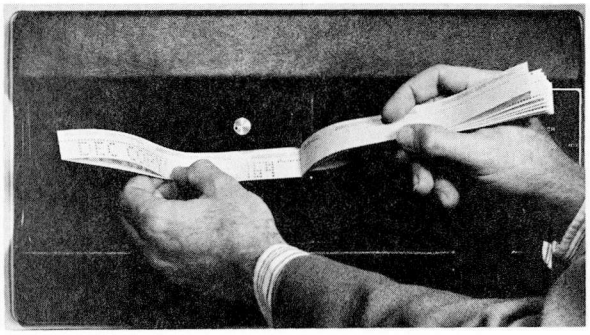


Figure 3-1 Paper Tape Path, Top View

3.3.2 Loading Prepunched Tape (Figure 3-2)

To load prepunched tape for reading, proceed as follows:

Step	Procedure
1	Raise the tape depressor and load the tape into the right-hand bin. Thread the tape under the tape hold-down bracket.
2	Place the tape on the sprocket teeth and lower the tape depressor fork. Press the READER FEED switch. Run the tape leader into the left-hand bin and dress the tape folds.



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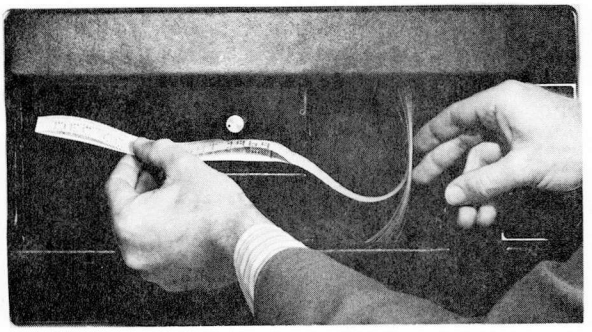

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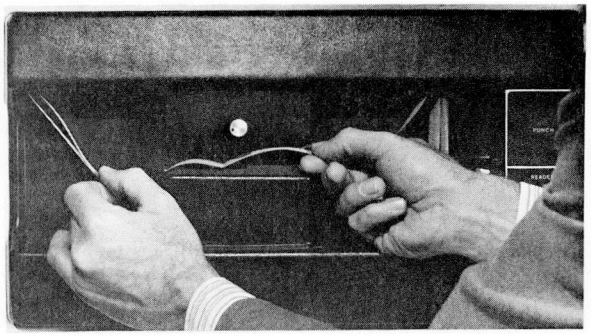

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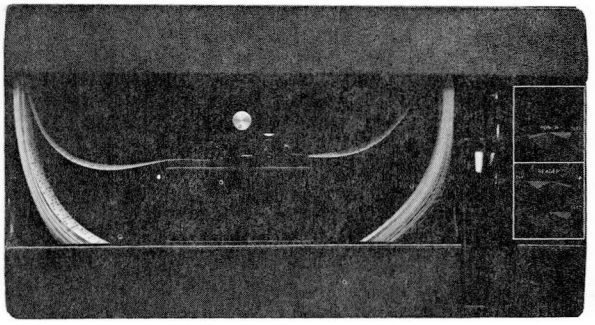

4.

Figure 3-2 Installing Tape in Paper-Tape Reader

CHAPTER 4
PRINCIPLES OF OPERATION

This chapter describes the principles of operation for the paper-tape reader (refer to Paragraph 4.1) and the paper-tape punch (refer to Paragraph 4.2). The engineering drawings referenced in this chapter are contained in Volume 2 of this manual. The principles of operation of the PC05 are described, but they are the same for all versions of the reader and punch. A list of all drawings contained in Volume 2 is included in Chapter 6.

4.1 PAPER-TAPE READER

The power and control schematic for the paper-tape reader appears on engineering drawing D-BS-PC05-0-4, and D-BS-PC04-0-2.

4.1.1 Tape Feed Operation (Figure 4-1)

Rotation of the reader motor is dependent on the simultaneous actuation of two halves of its two center-tapped windings. The drive current for the windings is provided by four M040 Solenoid Driver Modules. There are actually two drivers per module resulting in eight current drivers or two for each half winding. The stepped activation of both drivers in each of two selected modules supplies the current necessary to produce the required torque.

Independent gates are provided at the input of each of the eight current drivers. The output of the A or B flip-flop activates one driver of each pair. Each of these drivers feeds into a series-connected current-dividing resistor. The jumpered ends of the resistors from each module connect to one side of a winding of the motor. Each section of a driver module provides 600 mA to a motor winding. With the A and B flip-flop outputs active, only one driver in each of the two selected modules is activated. Therefore, only 600 mA is applied to a winding, and the torque produced by this current, although insufficient to produce motor rotation, acts as an efficient holding force.

To fully actuate a motor winding, the second driver in the two selected modules is enabled. This is accomplished by applying the set output of the POWER flip-flop to the second driver. With both drivers in each of the two modules enabled, the output current rises to 1.2A, which is the current required to rotate the motor.

For example, with flip-flop A (0) and flip-flop B (0) a +3V-level is applied to pins D2 and K2 of the two modules located at A09 and B07. This condition supplies two of the three required inputs. (Therefore, levels A (1) and B (1) are false, disabling the drivers located in slots A10 and B08.) The application of a +3V-level (POWER (1)) to pin E2 of all modules provides the third input required to the drivers in A09 and B07.

As a result of these three inputs, both sections of drivers in A09 and B07 conduct, providing drive current to windings 4 and 2. This drive current rotates the motor 1.8 degrees. Switching the driver inputs 200 times results in one complete revolution of the motor (1.8 degrees x 200 = 360 degrees). One motor revolution is equivalent to 100 character positions. Continuous stepping of the inputs in the proper sequence (see chart in Figure 4-1) at the rate of 1.667 ms per step produces a tape-feed rate of 300 characters per second.

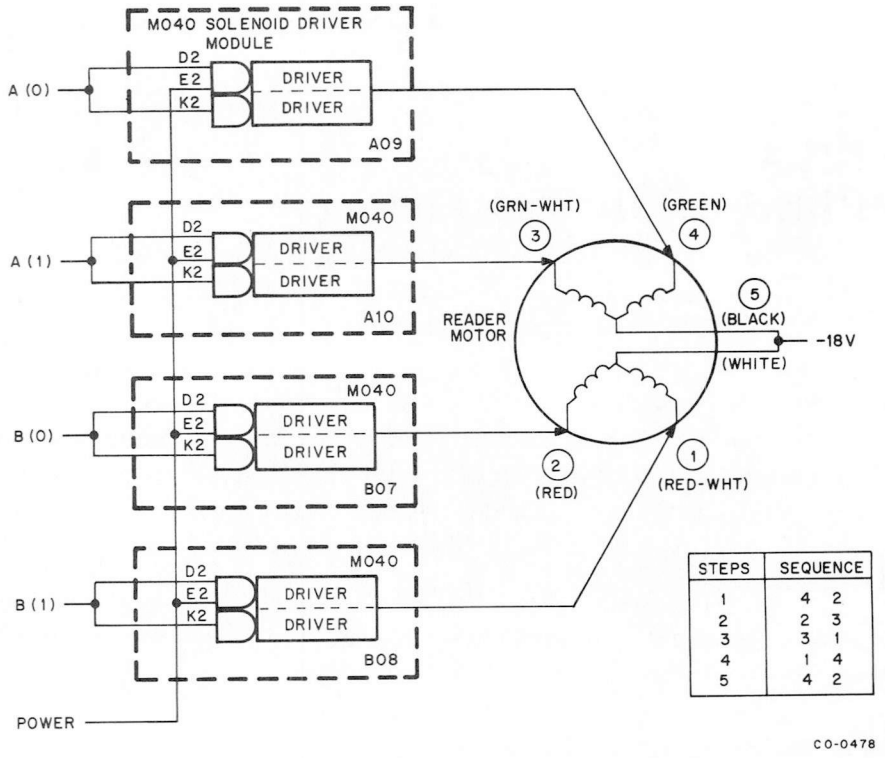

Figure 4-1 Tape Feed Operation

4.1.2 Tape Reading

The photoarray, consisting of nine photosensitive transistors, is arranged below the tape track perpendicular to the direction of tape movement. A light source, located directly above the phototransistors, provides the light necessary for sensing holes in the tape. Eight of the phototransistors sense the coded holes; the ninth senses the feed holes.

The phototransistor, when shuttered from light, controls an output that is below the threshold of the photoamplifier. If the phototransistor is exposed to light, its output current increases in a positive direction and overcomes the circuit threshold.

The photoamplifier, which consists of nine amplifiers, is used to monitor the outputs of the photoarray. The photoamplifier provides an output of 5 Vdc when a hole is sensed, and an output of 0.2 Vdc when no hole is sensed.

The following discussion describes the operation of the channel 1 phototransistor amplifying circuit. All other channels operate in an identical manner. The referenced amplifying circuit is at the top left of engineering drawing D-BS-PC05-0-4, sheet 1.

The photoamplifier (G918) accepts the output of the photocell for channel 1 at terminal BP2. When the photosensor does not sense light (no hole), the bias level (determined by the setting of the threshold sensitivity potentiometer) is not overcome, which causes a 0 Vdc output at AE2. When the photosensor senses light, a positive current change occurs at terminal BP2, which is enough to overcome the circuit current threshold, and the output switches to +5V at AE2.

Approximately 0.1 ms after the data holes are over the photoarray, the feed hole signal rises, strobing the data into the reader buffer in the M7050.

4.1.3 Tape Reader Control

Regardless of the central processor, the control for the PC04/PC05 is such that the next character to be read is already directly over the photoarray. The following discussion outlines the cycle involved in reading a character.

a. The central processor issues a fetch character command that generates a tape-advance signal to the reader. Before this tape-advance signal is actuated, however, the data that is already over the photoarray is strobed into the buffer register.

b. When the data is stored in the buffer register, the reader control module M7050 issues the reader flag.

c. On detecting the reader flag, the processor issues a command that strobes or gates the data onto eight input-output bus lines and to the central processor.

d. The tape-advance signal generated in step *a* brings the next character over the photoarray, and the process described above is repeated.

4.1.4 Out-of-Tape

The out-of-tape condition arises when attempting to read with no tape in the reader. A 10 ms one-shot is retriggered with each fall of the feed hole (tape web). As long as the one-shot is "on", an out-of-tape does not occur. If, while trying to read tape, no feed holes are detected, the one-shot times out and an out-of-tape condition exists. This condition inhibits further attempts to read. The out-of-tape is cleared by covering the feed hole sensor when reloading tape in the reader. While stopped between blocks of information, the out-of-tape one-shot is prevented from timing out by enable being low.

4.1.5 Strobe

Strobe is generated from the signal derived from the feed hole. When the motor has rotated enough to have data over or approaching the photosensors, a gating flip-flop is turned on. This flip-flop allows detection of a feed hole and thus generates a strobe. The rise of strobe turns off the above flip-flop and prevents noise on the feed hole line from generating further strobes. Another strobe is allowed after additional motor rotation.

4.2 PAPER-TAPE PUNCH

The power and control schematic for the paper-tape punch appears on engineering drawing D-BS-PC05-0-4, sheets 1 and 2.

4.2.1 Feed Control

A reluctance pick-up (Pulse Generator) signals the M710 Punch Control Module when the punch mainshaft has rotated to an angular position marking the beginning of the punch cycle. If a character is in the punch buffer at the time that the pulse generator signal occurs, the punch control immediately applies a voltage across the index magnet coil and appropriate punch magnet coils.

When the flux in the index magnet coil has built up enough to overcome the spring return force, the magnet armature "pulls in" and engages a tooth on the feed ratchet. Continued rotation of the punch mainshaft tries to draw the ratchet past the magnet armature. The armature, however, is held stationary and acts as a pawl, resulting in a rotation of the ratchet. The feed ratchet drives the sprocket wheel through a pair of gears. In this manner, motion of the paper tape is initiated.

A ball detent on the sprocket wheel shaft is used to accurately position the tape and then hold the tape motionless during the ensuing punching operation. Activation of the punch magnets by the solenoid drivers causes

interposers to be set up. As rotation of the punch mainshaft continues, these interposers push the punch pins through the paper. As the punch pins are being retracted from the paper, the punch mainshaft is just completing one revolution. The reluctance pick-up again signals the logic that the machine is starting a new cycle and is ready to punch another character.

4.2.2 Tape Punch Control

The punch is selected for operation when it senses its device code or address from the current instruction. Command pulses or data lines are then asserted by the central processor, which subsequently causes IOT pulses to be generated within the M710 Punch Control Module. The IOT pulses clear the punch buffer, load the buffer with new data, and cause various flags to indicate the state of the punch to the central processor.

A typical operation follows (see Figure 4-2). The punch control senses its device code being transmitted by the central processor unit (CPU). The CPU checks if the punch is currently active and, if not, sends a command to clear the punch buffer. Data is then strobed into the buffer from the CPU input-output bus.

A punch command is then sent by the CPU or is generated by the punch FEED switch, and the punch motor is activated by the SCR. After a 0.4-sec delay to allow the motor to reach full speed, the solenoid drivers are activated, and the punch is allowed to start punching the data in the buffer (PB0-7).

When the punch command is disabled or the punch FEED switch is released, the timer in the M710 module will time-out after three seconds, unless another punch command is received, and then stops the motor.

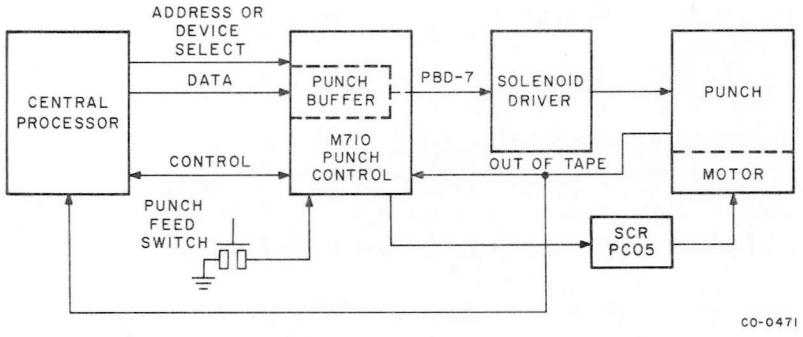

Figure 4-2 Simplified Block Diagram, Punch Operation

The OUT-OF-TAPE signal provides a warning when approximately 2 in. of tape remains (PC05 only).

CHAPTER 5
MAINTENANCE

5.1 INTRODUCTION

This chapter contains both preventive and corrective maintenance procedures. An optimum amount of preventive maintenance, performed on a routine schedule, can eliminate costly equipment breakdowns and allow the detection of impending failures. If a specific item does fail, equipment design is such that replacement of modular elements can restore the equipment to service in a minimum amount of time. The design objective of the PC04/PC05 High-Speed Paper-Tape Reader/Punch is to provide a dependable and relatively maintenance-free assembly. The tape reader motor is electromagnetically driven; thus, it does not experience the mechanical failures normally inherent in systems using ratchets, detent, and clutch-brake mechanisms.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance tasks should be performed at periodic intervals to ensure proper equipment operation and to minimize unscheduled downtime, These tasks consist of visual inspection, operational checks, cleaning, lubrication, adjustment, and replacement of borderline, or partially defective parts.

Preventive maintenance scheduling is contingent on the environmental and operating conditions at the installation site. Under normal environmental and work-load conditions routine preventive maintenance should be performed after every 600 hours of operation (or every four months, whichever occurs first). This schedule should be modified when extreme temperature, humidity, dust, or work-load conditions exist.

Maintenance activities for the PC04/PC05 require the standard test equipment and special materials listed in Table 5-1.

Table 5-1
Required Maintenance Equipment

Equipment	Manufacturer	Designation
Multimeter	Triplett or Simpson	Model 630-NA or 260
Oscilloscope	Tektronix	Type 547 or 453
Plug-in Unit	Tektronix	Type CA (for 547 scope)
X10 Probe	Tektronix	P6008
Module Extender	DEC	Type W980
Tape Registration Gauge		

5.2.1 Preventive Maintenance Procedures

Preventive maintenance procedures for the tape punch can be found in the *Roytron Maintenance Manual,* which is supplied with the equipment.

5.2.1.1 Mechanical Checks – Inspect the tape reader periodically as follows:

Step	Procedure
1	Visually inspect the general condition of the tape reader.
2	Clean the interior and exterior of the tape reader, using a vacuum cleaner or a clean cloth that has been moistened with a nonflammable solvent.
3	Lubricate the chassis slide mechanisms with a light machine oil. Wipe off excess oil.
4	Inspect all wiring and cables for cuts, breaks, fraying, deterioration, kinks, strain, and mechanical security. Tape, solder, or replace any defective wiring or cable covering.
5	Inspect the following components for mechanical security: READER FEED switch, READER ON/OFF LINE switch, light condensor, phototransistor assembly, depressor arm, hold-down bracket, all connectors and circuit modules, tape-feed motor, front cover, and resistor assembly.

5.2.1.2 Electrical Checks – Perform the power supply output checks described in Table 5-2. With the normal load connected, use a multimeter to measure the output voltages and an oscilloscope to measure the peak-to-peak ripple content on all dc outputs of the supply. The +5 Vdc and -15 Vdc supplies are adjustable. The -18 Vdc and -36 Vdc supplies are not adjustable.

Table 5-2
Power Supply Output Checks

Output Voltage		+5V ±0.25V	-15V ±1V	-18V ±2V	-36V ±4V
Ripple (Peak-to-Peak)		0.1V	0.1V	1.0V	1.0V
Pin Numbers	PC04 (8I)	A1A	A1B	B6V	B2D
	PC04 (8E, 8L)	A1A	A1B	B6V	A5V
	PC05	A1A2	A1B2	B8V2	A8V2

5.3 PC04/PC05 READER ADJUSTMENTS (FEED-HOLE STROBED MODELS)

5.3.1 Introduction

This section contains the adjustment procedures for the PC04 and PC05 paper-tape readers that strobe data by the signal derived from the feed holes. The procedures should be followed as closely as possible and should be performed in the order in which they are presented.

Tools and equipment required are listed in Table 5-1. MAINDEC diagnostic programs are listed in Appendix A. A summarized setup procedure is given in Appendix D. If the unit can read programs, it is advisable to load the diagnostic in at this time. If not, a ONE-ZERO test tape can be made with a toggle-in routine given in Appendix B. A read and stall routine can be found in Appendix C.

This procedure was written for a completely misadjusted machine; adjustments that are already correct need not be redone. It is good policy, however, to check each adjustment to make sure it is correct.

5.3.2 Preliminary Adjustments

Step	Procedure
1	Remove power from reader.
2	Remove tape depressor knob by loosening the two Allen screws that secure it on the shaft.
3	Remove the reader front panel by removing the four Phillips screws that hold it to the front plate.
4	Remove the protective screen that covers the reader modules and power supply.
5	Apply power and ensure that +5V = 5V ± 0.25V and -15V = 15V ± 1.0V. Adjusting potentiometers can be found on the regulator board. (Refer to Table 5-2 and Figure 5-1.)

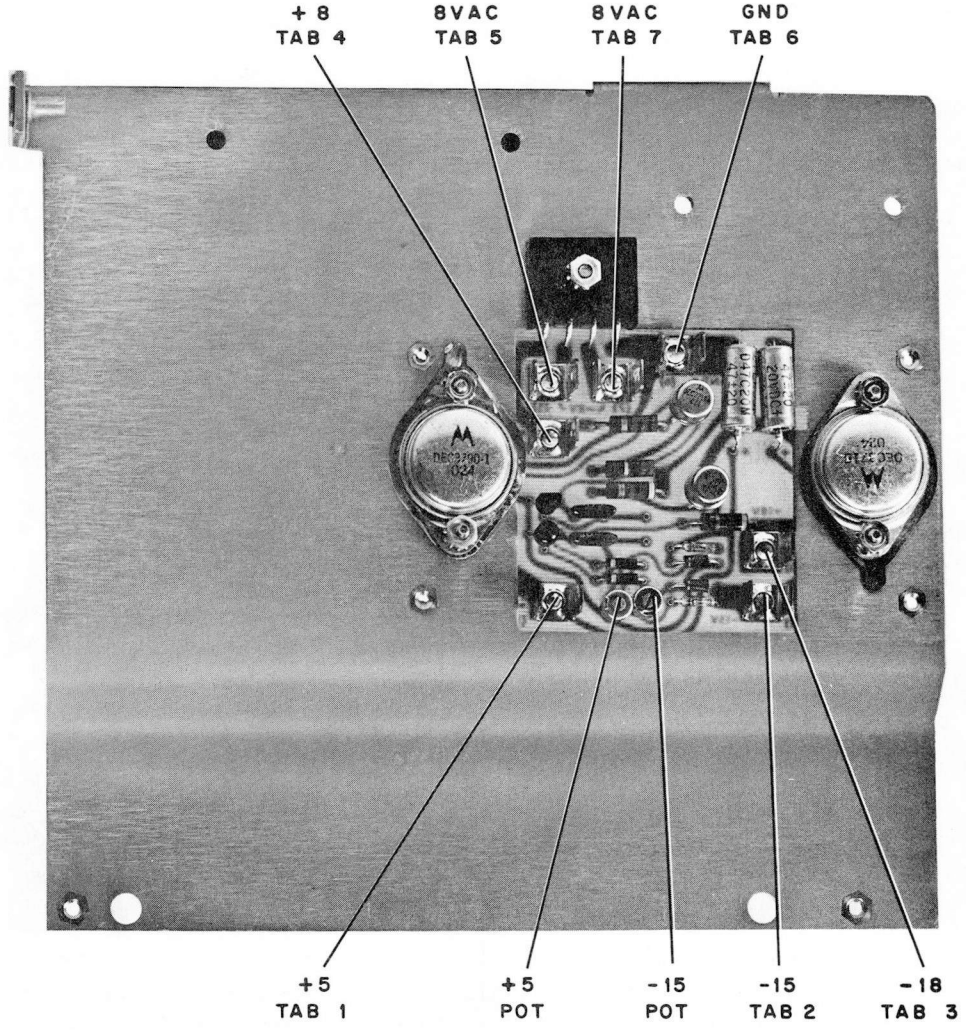

Figure 5-1 Regulator Board

5.3.3 Test Tape Registration

The following reader adjustment procedure uses the tape output from the punch or a prepunched tape. If this tape is not in accurate registration (ten characters per inch), the reader may not be able to read other tapes, such as DEC Program Library tapes. To check registration, use the following procedure:

Step	Procedure
1	Obtain a prepunched ONE-ZERO tape or generate a tape with a MAINDEC or a toggle-in routine listed in Appendix B.
2	Use the pins on the tape gauge to check that the registration is not off by more than one-half feed hole per 6 in. of tape.
3	The tape gauge provides holes 1 in. apart. Check that every one of these holes is uncovered. If some holes are covered and the feed holes line up with the two pins 6 in. apart, registration is off by a multiple of one hole spacing.
4	It is also important that the feed holes be evenly spaced 0.1 in. from each other. This can be checked by sighting along the punched tape at a shallow angle.

5.3.4 Feed Wheel and Motor Adjustment

The purpose of this adjustment is to properly position the feed wheel on the motor shaft, thus, placing the data holes in the paper in their proper relationship with the photosensors.

Step	Procedure
1	Advance the feed wheel by momentarily pressing the FEED switch. This will ensure that the motor stops on a character and not between characters.
2	Install a piece of ONE-ZERO test tape (about 6 in. long) over the photo array and hold it on the feed wheel by means of the tape depressor.
3	Loosen the four mounting screws that hold the motor to the back plate (three in front, one in the rear).
4	Position the motor to the center of its rotational swing and tighten the mounting screws. Repeat Step 1.
5	Loosen the two Allen screws that hold the feed wheel to the motor shaft.
6	Move the feed wheel in or out so the tape just comes in contact with the back plate. The tape must not be jammed against the back plate, nor should there be a gap between the tape and the back plate. Jamming will cause paper handling problems and a gap can cause skew. At the same time, rotate the feed wheel on the shaft until the holes in the tape have approximately the relation to the photosensors as shown in Figure 5-2. Tighten the Allen screws. If the Allen screws have dented the shaft, it may be difficult to make a small correction, since the screws tend to slide back into the original dents. To correct this, rotate the wheel on the shaft about one quarter turn and repeat this step. The important adjustment in this step is the in and out adjustment. Be sure the tape is not jammed.
7	Loosen the motor mounting screws again and rotate the motor until the holes and photosensor appear as in Figure 5-2. This position of the tape allows for the maximum margin in case of an off registration tape. Repeat Step 1 and check the alignment per Figure 5-2.

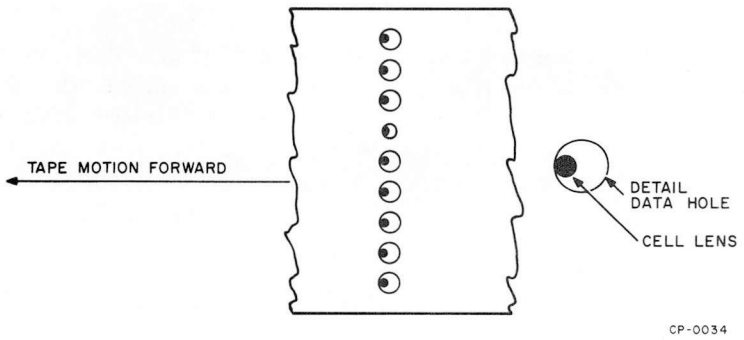

Figure 5-2 Feed Wheel and Motor Adjustment

5.3.5 Tape Depressor

Step	Procedure
1	Loosen the two Phillips screws holding the tape depressor to the shaft.
2	Place one thickness of unpunched paper tape (except for feed holes) on the feed wheel and lower the tape depressor.
3	Apply light finger pressure on the horizontal position of the tape depressor, centering the slot in the depressor around the feed wheel teeth (see Figure 5-3).
4	Tighten the screws. The heel and toes of the depressor should now make a four-point contact with the paper, holding it evenly against the feed wheel.

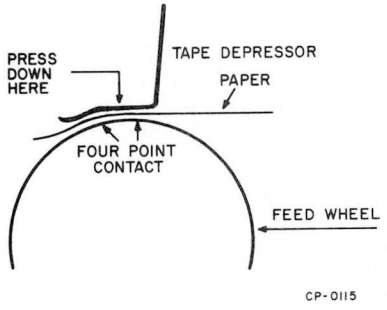

Figure 5-3 Tape Depressor

5.3.6 Tape Hold-Down Bracket

The purpose of this adjustment is to limit the vertical motion of the tape as it passes the read station, yet allow room for passage of splices and folds.

Step	Procedure
1	Loosen the two Phillips screws holding the bracket to the back plate.
2	Insert three thicknesses of unpunched tape (no folds included) under the hold-down bracket and up against the back plate.
3	Press down carefully on the left-hand side of the hold-down bracket and tighten the screws (see Figure 5-4).

(continued on next page)

Step	Procedure
4	The tape should have even tension as it is being pulled out. If not, the bracket is bent, and not parallel with the tape path guide. Remove the bracket and adjust it, checking it with a square or the right angle formed by the tape path guide and the back plate. Remount and readjust. When the tape depressor is properly adjusted, point A limits tape skew and point B keeps the paper close to the photoarray (Figure 5-4). Maladjustment at either point can cause misreads.

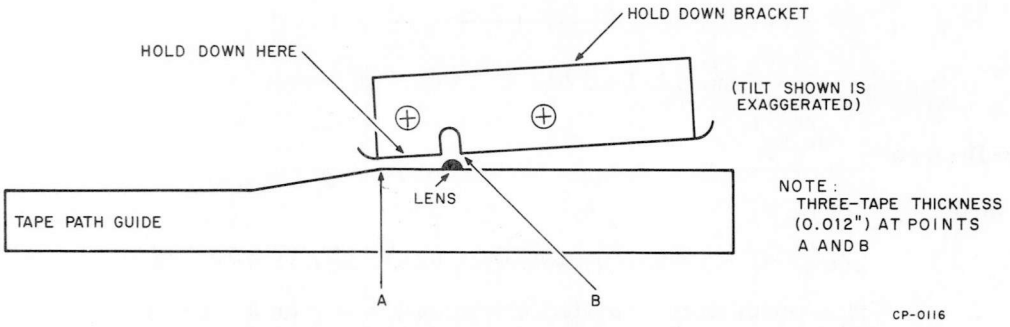

Figure 5-4 Tape Hold-Down Bracket

5.3.7 Lamp, Lens, and Light Pattern

Step	Procedure
1	Set the adjustable resistor in the lamp circuit (see Figure 5-5) for minimum resistance (maximum brightness). This will reduce the effects of stray outside light.
2	Due to the offset filament in the lamp, the lamp should be placed in the reader so that the end with the lettering is nearest the back plate. This position will give a more uniform light at the photoarray. Rotate the lamp so the seam is not projected on the photoarray.
3	Loosen the lens and rotate it so the light beam is concentrated and centered over the photoarray. A ONE-ZERO tape with the holes over the photoarray will help define the light pattern. The pattern should appear as in Figure 5-6.

5.3.8 Full-Speed Running Rate

Proceed as follows to adjust the full-speed running rate to 300 characters per second, ±5 CPS:

Step	Procedure
1	Connect an oscilloscope to the A(0) flip-flop (refer to Table 5-3 for pin locations).
2	Run the reader at full speed using either the reader FEED switch or program control.
3	Check the time between transitions of the A flip-flop. The time should be 3.33 ms (three transitions in 10 ms). The time is adjusted by R6 on the M715 (or R27 on the M840 for a PC8E) (see Figure 5-7A).
4	Check the output (pins R and S) of each M040 Motor Driver Module. Module locations can be found by referring to Table 5-3. A bad waveform causes faulty start and stop characteristics and can be caused by a bad M040 or a broken wire leading to one of the 25-ohm, 40W motor resistors. The desired waveform is shown in Figure 5-7B. Figure 5-7C is an example of a faulty waveform.

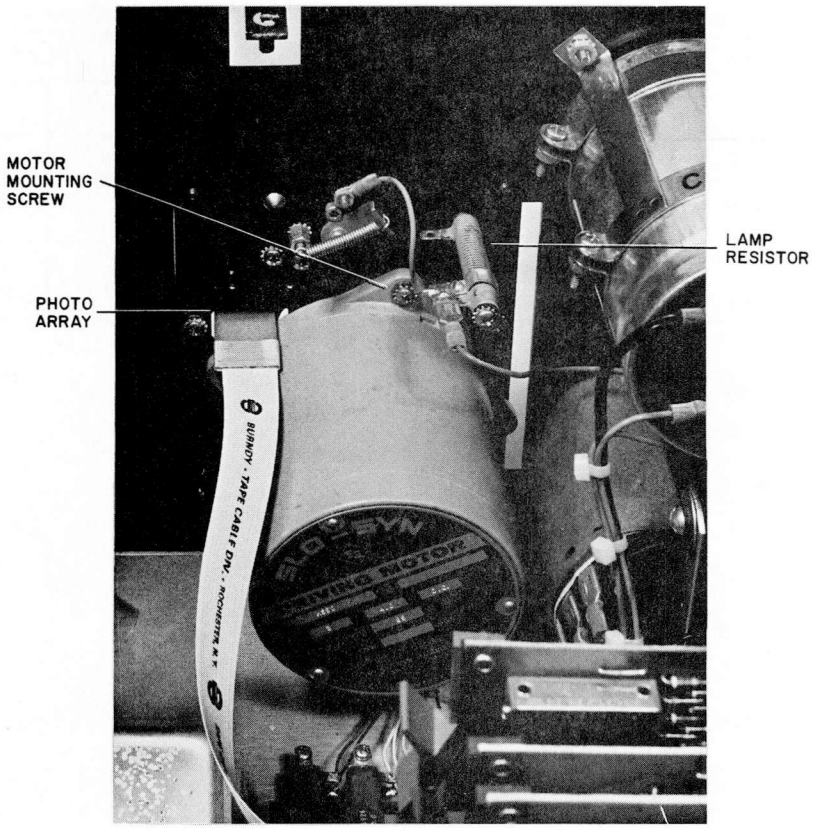

Figure 5-5 PC04/PC05, Rear View

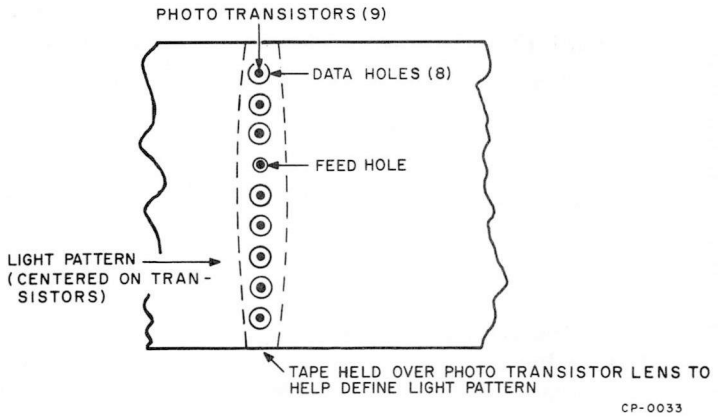

Figure 5-6 Light Pattern

Table 5-3
M040 Motor Driver Input and Output Pin Locations

	PC8I		PC8E & 8L		PC05	
	In	Out	In	Out	In	Out
BA (0)	A2P	B3 R&S	A1P	B3 R&S	A9 D2	A9 R&S
BA (1)	A2R	B4 R&S	A1R	B4 R&S	A10 D2	A10 R&S
BB (0)	A2S	B5 R&S	A1S	B5 R&S	B7 D2	B7 R&S
BB (1)	A2T	B6 R&S	A1T	B6 R&S	B8 D2	B8 R&S

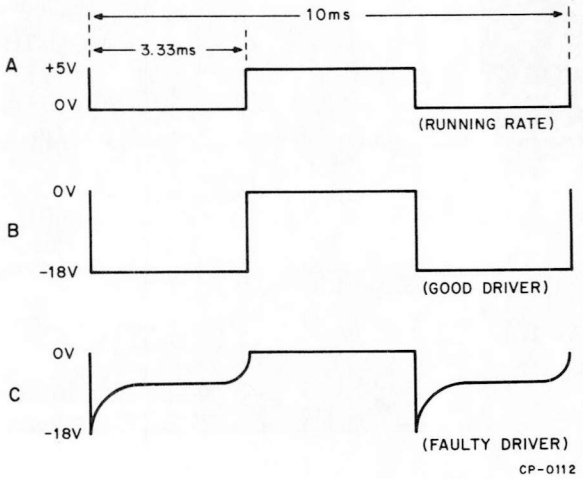

Figure 5-7 M040 Input and Output Waveforms

5.3.9 Acceleration and Stop Delay

Proceed as follows to determine if the acceleration rate and the stop delay are within specifications. There is no adjustment. Corrective action should be taken if either condition is not met.

Step	Procedure
1	Load a program that will read *two* characters and then stall for approximately 5 ms. Use the MAINDEC program or a short routine listed in Appendix C. The 5-ms stall allows the internal machine stall (stop delay) to activate.
2	Connect the oscilloscope to the A (0) flip-flop (refer to Table 5-3 for pin locations). The waveform should be either a positive or negative pulse train as shown in Figure 5-8. The polarity depends on the motor phase the program happens to start on. Be sure to trigger the oscilloscope on the leading edge of the narrower pulse, which should be 6 to 7 ms wide. The longer internal pulse is the stop delay and should be 30 to 70 ms. (Use 10 ms/cm on the oscilloscope to view this.)

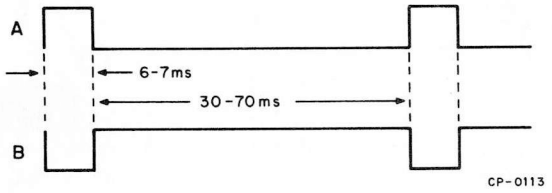

Figure 5-8 Acceleration and Stall Waveforms

5.3.10 Threshold and Skew

Skew can be caused by feed wheel wobble. This wobble causes the tape to walk in and out across the photoarray, varying the outputs of the photoamplifiers. Skew can also be caused by array placement in the tape path guide and placement of the individual sensors on the array board. The relative sensitivity of each sensor in the array will also cause skew.

Step	Procedure
1	Using a ONE-ZERO test loop, operate the reader at full speed by either program control or the FEED switch.
2	Set the oscilloscope to 1 ms/cm, 1V/cm, triggering internal positive.
3	Connect the probe to the feed hole output of the G918 test point. See Table 5-4 for the pin location.

Table 5-4
G918 Photoamplifier Pin Locations

	PC04	PC05
RH 1	A7 E	A11 E2
RH 2	A7 F	A11 F2
RH 3	A7 J	A11 J2
RH 4	B7 D	B11 D2
RH 5	A7 L	A11 L2
RH 6	A7 N	A11 N2
RH 7	A7 P	A11 P2
RH 8	A7 R	A11 R2
Feed Hole	A7 T	A11 T2
Sum (TP)	A7 V	A11 V2

4	Adjust the potentiometer on the G918 for a feed hole pulse width of approximately 1.5 ms. (Measured at the 10% point.)
5	Observe the pulse stability. If the width varies more than 500 μs (1/2 ms) at a 3 cycle per second rate, the feed wheel wobble is too great and the feed wheel must be replaced. Because the feed wheel makes 3 revolutions per second, the wobble signal will be a harmonic of 3 Hz. Do not mistake the passage of the tape loop splice for a variation. Attempts to straighten the feed wheel are usually ineffective. If the feed wheel must be replaced, repeat the procedure in Paragraph 5.3.4.

(continued on next page)

Step	Procedure
6	Observe the waveform at the SUM TP of the G918. It should appear as shown in Figure 5-9 (A). Measure the time "T" between the last data bit rise and the feed hole (slow rise signal). The time should be greater than 0.1 ms. If not, adjust by rotating the photoarray in its mounting hole as follows: Loosen the mounting screw of the photoarray enough to allow light, finger-pressure movement of the array. Gently rotate the array to maximize the time "T". Tighten the screw.
7	Turn the potentiometer on the G918 counterclockwise until a data bit is picked up in the all 0s section of the waveform. (Do not mistake the feed hole signal when reading all 0s with a picked up bit). Then while counting the turns, turn the potentiometer in the opposite direction until a data bit or the feed hole is dropped in the 1s section of the waveform and set the potentiometer to the middle of these two extremes. These adjustments should be made using the tape with the highest transmissivity to be used on the system. For instance, if the reader is to read oiled tape, the threshold adjustment should be made while using oiled tape.

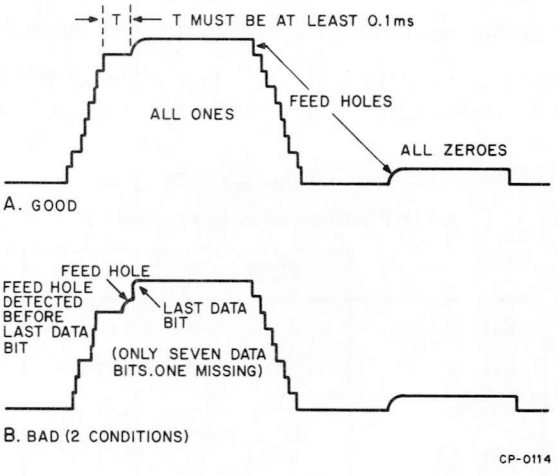

Figure 5-9 Summation Waveform, G918 Test Point

8	Recheck for a minimum of 0.1 ms time "T" as described in Step 6 above.

5.3.11 Testing and Error Correction

When the adjustment procedure is completed, test the reader for proper operation by reading a tape for which there is an error checking routine. The Special Binary count is recommended. If a test loop is used, be careful that the splice does not generate a false error indication. For testing purposes only, the tape can be run from the punch to the reader if the MAINDEC program allows. Review Appendix D for the summary set-up procedure to be sure all adjustments have been completed.

5.3.11.1 Data Bits Picked Up – Data Bits are picked up if:

a. Photosensor not turning on. Return to threshold adjustment (refer to Paragraph 5.3.10).

b. Photoarray exposed to stray light (determine if sunlight is falling on the reader).

c. Data is picked up during transmission to processor due to faulty reader control module, cable, or processor.

5.3.11.2 **Data Bits Dropped** – Data bits are dropped if:

a. Photosensor not turning on. Return to threshold adjustment, Paragraphs 5.3.7 and 5.3.10.

b. Skew. Return to Paragraphs 5.3.4, 5.3.6 and 5.3.10.

c. Data is dropped during transmission to processor due to faulty reader control module, cable, or processor.

5.3.11.3 **Skipping Characters** – Skipping characters is caused by dropping the feed hole, which can be caused by:

a. Skew. Return to Paragraphs 5.3.4, 5.3.6, 5.3.8 and 5.3.10.

b. Threshold set incorrectly (refer to Paragraph 5.3.10).

5.3.11.4 **Double Reading** – If the reader reads a character twice, ensure that the adjustments in Paragraphs 5.3.4, 5.3.6, 5.3.8 and 5.3.10 are properly made.

5.3.11.5 **Dropping Flags** – The processor may lose the reader flag because of an out-of-tape indication. This may happen because of missing reader strobes (refer to Paragraph 5.3.11).

5.3.11.6 **Out-of-Tape Circuit** – The out-of-tape circuit clears itself when a web is found. If a web does not occur within 10 ms of an enable-to-read, the out-of-tape occurs, the flag is reset, and further commands to read are ignored. A bad M040 motor driver can cause a slow enough start that the 10 ms one-shot will timeout before it is retriggered by the next feed hole. Recheck M040 waveforms, Paragraph 5.3.8, Step 4.

5.3.11.7 **Acceptance Testing** – With all adjustments complete, the PC05 is capable of running any program. A reasonable acceptance program consists of running one box of tape, which is equivalent to 6 in. of vertical stacked height. For reference, each vertical inch represents 6 to 8 minutes of full-speed punching time.

5.4 PUNCH ADJUSTMENT PROCEDURES

5.4.1 General

This section contains adjustment procedures for the punch mechanism. Additional information can be obtained from the *Roytron Maintenance Manual,* which is supplied with each unit.

5.4.2 Tape Output Quality

At times, troubles relating to data being dropped or picked up can be caused by incorrect alignment of feed and data holes. Figure 5-10 shows the correct dimensions for paper tape in accordance with the USA Standard for 1-in. perforated paper tape.

Punched-hole diameters and transverse centerline dimensions are almost never out of specification because the punches and die blocks are made from hard tooling. There are no adjustments involved in setting up these dimensions.

Two dimensions that do involve mechanical adjustments are the 0.392-in. dimension from the feed hole centerline to the reference edge of the tape, and the 0.100-in. dimension between adjacent feed holes. Both of these dimensions depend on properly positioning the sprocket wheel on its shaft. If the 0.100-in. dimension is consistently long or consistently short, adjustment of the angular position of the sprocket wheel on its carrier shaft will eliminate the problem.

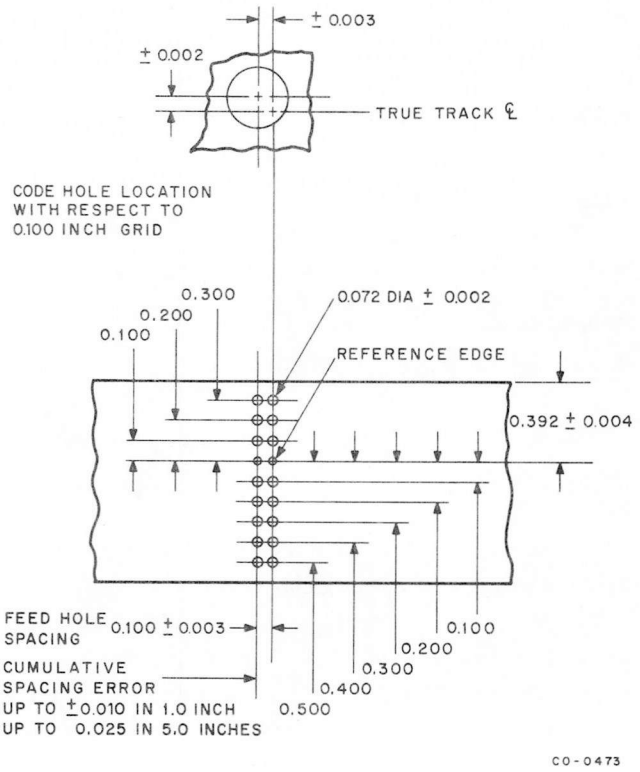

Figure 5-10 Specifications for 1-In. Paper Tape

5.4.2.1 Sprocket Wheel Adjustment – Burrs on the sides of the feed holes indicate that the sprocket wheel is not positioned to pull tape squarely through the punch. Adjust the sprocket wheel as follows:

Step	Procedure
1	Loosen the set screws on the sprocket wheel and slide the wheel along its shaft until the sprocket teeth are directly in line with the feed hole punch.
2	Line up the sprocket by removing the tape skew guide at the rear of the die block and then placing a punched length of good tape in the die block. Ensure that the reference edge of the tape is squarely against the guiding edge of the die block. The feed hole in the tape can be used to accurately gauge the position of the sprocket.
3	Longitudinal registration may require adjustment after repositioning the sprocket. Once proper registration has been achieved, the set screws in the sprocket wheel must be tightened firmly so that the sprocket wheel does not creep sideways back into its original position.

5.4.2.2 Burred Feed Holes – Burrs on the front or back edges of the feed holes can be caused by excessive drag on the tape or by a timing problem in the sprocket wheel motion.

5.4.2.3 Elongated Feed Holes – If the paper drive sprocket moves while the punches are piercing the paper, the feed holes in the tape will be elongated or burred. There are several ways in which this can happen.

a. An eccentric shaft around which the entire punch yoke pivots determines the length of time allowed between the initiation of paper feed motion and the instant the punch pins enter the

(continued on next page)

paper. Improper angular positioning of this shaft may leave too little time for paper motion. The sprocket will still be moving the paper as the punches enter the paper. The punch pins will lock the paper in place, and the subsequent settling motion of the sprocket wheel will cause the feed holes engaged with the sprocket teeth to be elongated.

The time allowed between the feeding and punching operations is 7 ms ±0.3 ms or 126 degrees ±5 degrees of the punch cycle. The paper feed motion begins at 105 degrees in the punch cycle; the punch pins begin to pierce the paper at 231 degrees. The difference is the time allowed for paper motion.

b. A large diameter knob installed on the sprocket shaft of the punch will greatly increase the rotary inertia of the paper-positioning mechanism and will lengthen the time required to position the paper tape. As a result, even in a properly timed punch, the paper will still be moving when the punches enter the paper. The large knob must be replaced by a smaller plastic knob having an outside diameter no greater than 3/4 in. This knob is stocked as DEC part no. 12-09904.

c. A final adjustment affecting the motion of the paper concerns the forward indexing magnet. Specification of the adjustment of this magnet is given in Paragraph 5.4.6. If the magnet armature engages too far out on the ratchet tooth, the ratchet and sprocket will receive a larger than normal acceleration and a longer period of time will be required for the tape to be positioned. Punch pins will enter the paper before the paper has been properly positioned.

At 205 degrees in the punch cycle, the magnet armature must just miss contacting the ratchet tooth; otherwise, the paper drive sprocket will be disturbed and will not be able to reposition the tape before the punch pins enter the paper.

A simple registration adjustment will eliminate burrs on feed holes only if the feed hole spacing is drastically incorrect (more than 0.100 in. error per inch; i.e., 9 or 11 holes per in. instead of 10). In all other cases, the cause for burring must be corrected before attempting to register the punch.

5.4.3 Tape Depressor

The tape depressor mechanism (see Figure 5-11) is a new device that is added, by DEC, to the punch in place of the lucite cover and hinge. This mechanism is in the form of an assembly, which is held on the punch platen by two spring clamps and two screws. The assembly is properly positioned when the radius of the tape depressor arm conforms to the radius of the drive sprocket, and when the sprocket teeth pass through the slot provided in the tape depressor arm. The whole assembly is shifted to make these adjustments.

The latch is still used with this tape depressor but, now that the tape depressor is spring-loaded against the drive sprocket, the latch serves only to hold the depressor in place when tape is first started through the unit. In normal operation, there should be about 0.010-in. free play between the latch and the depressor tab.

5.4.4 Electrical Parameters (see Figure 5-12)

Basic timing for the punch system comes from a reluctance-type pulse generator, which supplies a positive-going and a negative-going pulse for every revolution of the punch mainshaft. The positive-going pulse signals the beginning of the punch cycle. If the amplitude of this signal is not great enough to trigger the electronics, the generator air gap must be reduced; this is done by loosening the generator coil assembly and moving it closer to the generator disc. The coil must not rub against the disc. The correct gap is .004 ± .002. Refer to Paragraph 5.4.6.1 to adjust the generator air gap.

It is possible for the coil core to become demagnetized. A weak signal will result. The core may be remagnetized by momentarily applying 36V to the coil. The voltage polarity is important. Proceed as follows:

a. With power off, remove punch cable card from its slot. Make a temporary connection from Pin F of cable card to -36V and connect Pin V to Ground. Turn the power on, then off. The coil is polarized. The punch cable card may be plugged into any *unused* slot in order to apply the polarizing voltages.

b. Remove temporary jumper wires and plug cable punch card back into its proper slot.

c. If the SYNC PUN signal remains below an acceptable level, the coil assembly may be defective. If placing a screwdriver blade against the exposed core end causes a significant rise in output level, it is an indication that the assembly should be replaced.

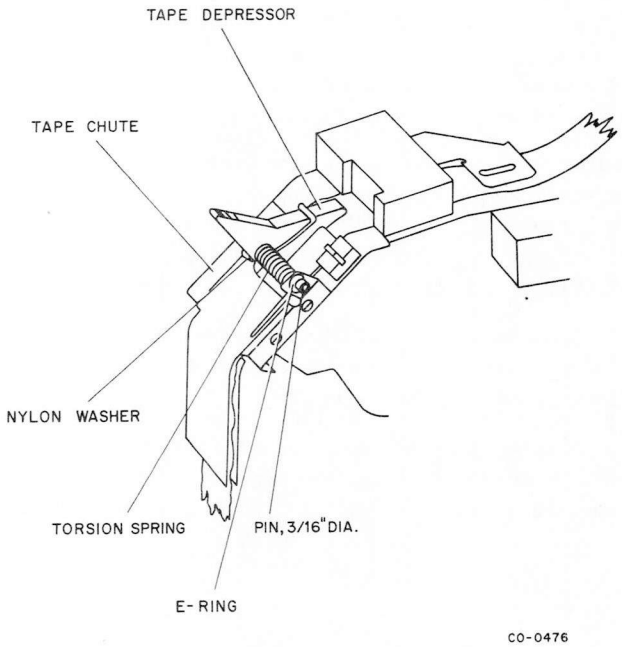

Figure 5-11 Improved Tape Depressor

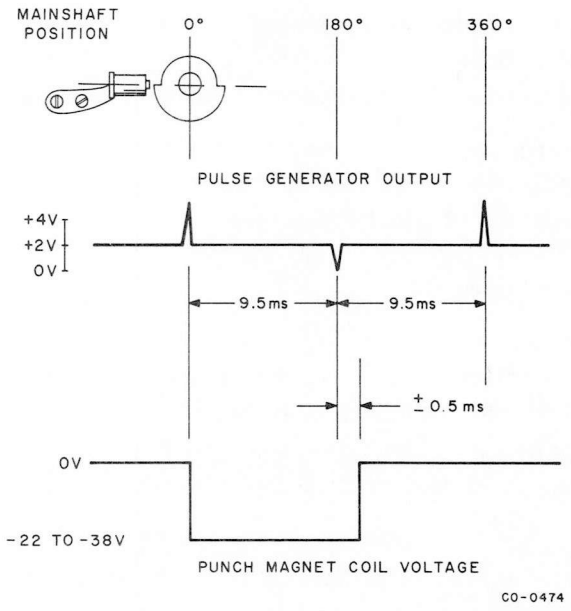

Figure 5-12 Electrical Parameters

Magnets in the punch must be energized by some voltage between 22 and 38V. Voltages are applied to the magnets at the beginning of the punch cycle and must remain for exactly half of the punch cycle. This is usually 9.5 ms, but it can vary slightly depending on line voltage, line frequency, and on the hole pattern being punched. (Punching all holes requires much more torque than punching only feed holes. The punch motor slows down slightly under increased load.) Turning the magnets off early may cause dropping of bits. Leaving magnets on too long will wear out the forward index magnet armature at its tip.

The gear ratio between the electric motor and the punch is critical. The punch mainshaft pulley has 18 grooves; 60-cycle motor pulleys have 16 grooves; 50-cycle motor pulleys have 20 grooves. A 50-cycle gear ratio unit plugged into a 60 cycle outlet will cause the punch to run too fast. Registration will be exceedingly poor.

5.4.5 Basic Timing

There are three basic adjustments that affect the times at which events occur within the punch.

When the punch starts its cycle, the first event is the engagement of the forward index magnet armature with the ratchet wheel. The magnet armature actually pulls in against the ratchet wheel, and the ratchet moving past the armature causes a tooth to be engaged and paper motion begins. This engagement must occur as early as possible in the punch cycle. As soon as the punch pins have been withdrawn from the paper during the preceding punch cycle, the new paper motion can occur. This is placed at 105 degrees in the punch cycle.

The next event is the piercing of the paper by the punch pins. This operation must be delayed for a period of time (7 ms) while the detent positions the paper. Piercing the paper begins at 231 degrees in the punch cycle.

Neither the 105 nor the 231 degree settings are critical in themselves. However, the difference between these two settings is critical (this is the time allowed for paper to move from one character position to the next). In general, if the difference in these two settings is less than 119 degrees, the punch probably will burr feed holes and will wander in and out of registration, depending on the hole pattern being punched, the fold position in relation to the punch die block at the time the hole is punched, etc.

Proper ratchet and pawl (armature) engagement is checked with the mainshaft rotated to the 205-degree position. At this point, with the pawl in its energized position, the ratchet and pawl are at their nearest point following the paper feed. The pawl should just contact the ratchet at this time, but no motion of the ratchet should result. If this adjustment is not correct, the ratchet must be repositioned on its shaft. This is easily done by loosening the two set screws in the ratchet. After making this adjustment be sure that the pawl is about 0.005 in. from contacting the root of the ratchet tooth when the pawl and ratchet are engaged.

Once the ratchet and pawl have been adjusted, the alloted time between feeding and punching of paper can be set. There are two methods to determine whether the proper amount of time is being allotted, but only one adjustment, the Pawl Carrier Eccentric Shaft, actually affects this time.

5.4.5.1 Method (1) – Refer to Figure 5-13. Remove the lucite chad guide and install gauges (DEC No. 29-15194) in the number 1 and 8 holes in the die assembly.

Select the number 1 and 8 punches and rotate the mainshaft (7) until the high point of shaft (7) is completely to the rear (307 degrees on the timing dial). The previously inserted pins must raise 0.080 ±0.010 above the surface of the plate (2).

When adjustment is required, loosen lock nuts (11) on both sides of the unit and turn Pawl Carrier Eccentric Shaft (10) to increase or decrease the amount of movement imparted to the punch pins.

5.4.5.2 Method (2) – Insert a feeler gauge or other hard flat device between the die blocks (1 and 2) so that the punch travel is obstructed. Set up a punch, and rotate the mainshaft (7) until the punch comes up against the feeler gauge. This should occur at 231 degrees in the punch cycle, or 126 degrees after the initiation of the paper-feed motion (which should occur at 105 degrees).

If adjustment is required, loosen lock nuts (11) on both sides of the unit and turn Pawl Carrier Eccentric Shaft (10) until the desired 126-degree difference is reached.

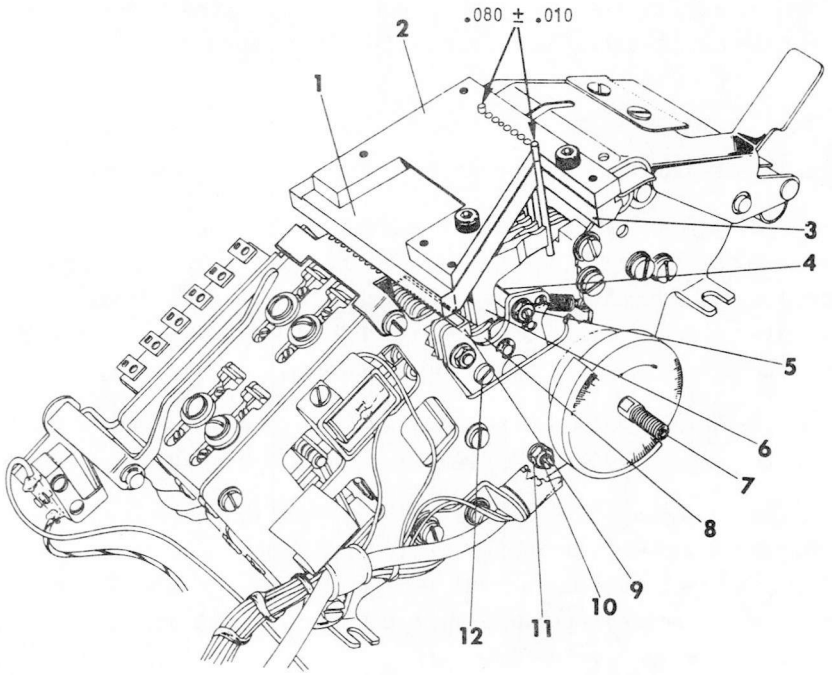

Figure 5-13 Punch Assembly*

NOTE
Changing the position of the eccentric shaft (10) may necessitate the adjustment of all eight punch magnet air gaps. It is not recommended that this magnet adjustment be attempted in the field.

5.4.6 Magnet Adjustments

There are three magnet air gap adjustments; all are critical.

5.4.6.1 Pulse Generator Air Gap – The Pulse Generator Air Gap is the easiest to adjust. Firmly pinch a single layer of paper tape between the coil pole piece and the pulse generator disc and tighten the pole piece in place.

5.4.6.2 Forward Index Magnet Armature Adjustment – The Forward Index Magnet Armature Adjustments (Figure 5-14) are the most critical adjustments in the machine and most frequently the adjustments in need of attention.

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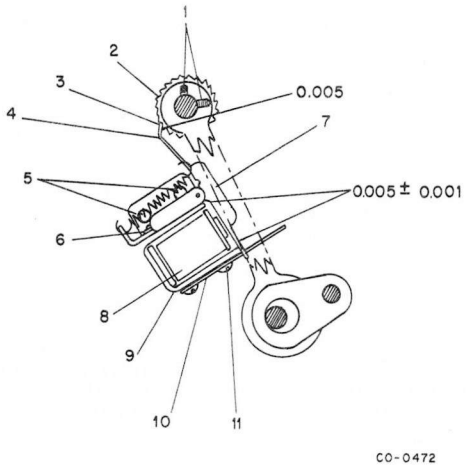

Figure 5-14 Forward Index Magnet Armature

a. The Armature Assembly (7), when operated, must have 0.005 ±0.001-in. gap between Magnet Shell (9) and Armature (7). Adjustment may be made by loosening Binding Screws (6 and 11) and repositioning either the Armature Assembly (7) or Plate (10).

b. Prior to performing the adjustments to the Indexing Ratchets, the Detent Wheel must be secure on the Sprocket Shaft, and the Detent Balls must be located in the Teeth of the Detent Wheel.

c. Index Magnet (8), when called, must bring Interposer (4) to within 0.005 in. of the bottom of Forward or Reverse Feed Ratchets (2).

d. The Index Magnet Armature may be held in its energized position by looping a rubber band around the armature and coil.

e. To adjust the Index Magnets, loosen Binding Screws (5), and move Magnet and Interposer Assembly to obtain the above clearance.

f. Rotate the Timing Dial to 205 degrees and operate Forward Interposer (4). Interposer (4) must contact Ratchet (2) with no play between the top of Interposer (4) and Ratchet Tooth (3). If adjustment is necessary, loosen Set Screws (1), and reposition Ratchet (2). Check this adjustment on all Teeth of the Ratchet.

g. On late style units, the Forward Index Magnet Rear Mounting Screw Hole has been enlarged to permit the Forward Index Magnet adjustment to be made in the following manner: Loosen Screws (5) and pull Magnet (8) to the rear of the Unit so the Rear Screw rests on the edge of the enlarged hole. Rotate Magnet (8) forward until Interposer (4) meets the 0.005-in. clearance as previously described. Tighten Screws (5).

5.4.6.3 Punch Magnet Adjustment – The Punch Magnet Adjustments (see Figure 5-15) are very difficult to measure without taking a side frame off the machine. It is not recommended that this be attempted in the field. The punch magnet adjustments are the least critical of the magnet adjustments, and a machine seldom requires attention in this area.

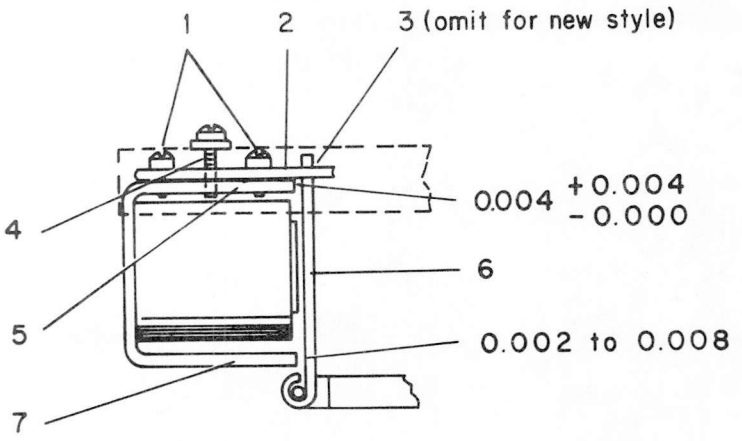

Figure 5-15 Punch Magnet

a. If adjustment is necessary, loosen Binding Screws (1) and move Plate (2) so there is 0.004 in. (+0.004, -0.000-in.) clearance between Armature (6) and Shell (5) as indicated, with Bowed Spring (3) in the position shown.

b. Set the Timing Dial at 127 degrees. There must be 0.002- to .008-in. air gap between Armature (6) and Point (7) of Shell (5). When required, loosen Screw (4) and move the Magnet forward or backward to obtain the aforementioned clearance.

CHAPTER 6
REFERENCE DRAWING LIST

This chapter contains a list of reference drawings required for maintenance of the PC04 and PC05. Table 6-1 lists the PC04 drawings by number and title and Table 6-2 lists the PC05 drawings. Table 6-3 lists the module circuit schematics. Refer to the appropriate Module Utilization List for applicable modules. The actual drawings are contained in Volume 2 of this manual.

Table 6-1
PC04 Engineering Drawings

Number	Revision	Title
D-DI-PC04-0-1	R	Drawing Index
D-UA-PC04-0-0	L	Unit Assembly
A-PL-PC04-0-0	L	Unit Assembly, Parts List
D-BS-PC04-0-2	F	Power and Control Schematic Diagram
C-MU-PC04-0-3	B	Module Utilization List
A-PL-PC04-0-3	A	Parts List, Modules
E-AD-7006268-0-0	D	Bus Bar
A-PL-7006268-0-0	D	Bus Bar, Parts List
A-SP-PC04-0-4	A	PC04 Engineering Specification

Table 6-2
PC05 Engineering Drawings

Number	Revision	Title
D-DI-PC05-0-1	S	Drawing Index
D-UA-PC05-0-0	M	Unit Assembly
A-PL-PC05-0-0	M	Unit Assembly, Parts List
D-BS-PC05-0-4	F	Power and Control Schematic
C-MU-PC05-0-3	B	Module Utilization List
A-PL-PC05-0-3	B	Parts List, Modules
C-AD-7006253-0-0	C	Bus Bar
A-PL-7006253-0-0	C	Bus Bar, Parts List

Table 6-3

PC04/PC05 Module Circuit Schematics

Module	Number	Revision	Title
G918	C-CS-G918-0-0	B	Photo Transistor Amplifier
M040	B-CS-M040-0-1	E	Solenoid Driver
M044	B-CS-M044-0-1	B	Solenoid Driver
M710	D-CS-M710-0-1	J	Punch Control
M715	C-CS-M715-0-1	L	Reader Clock
M840	E-CS-M840-0-1	F	Reader/Punch Control
M7050	D-CS-M7050-0-1	B	Reader Control

APPENDIX A
DIAGNOSTIC PROGRAMS

The following are suggested MAINDEC test programs.

Suggested MAINDEC Reader Test Programs

PDP-8E	MAINDEC-8E-D2CA
PDP-8, 8I, 8L, PDP-12	MAINDEC-08-D2GC
PDP-11	MAINDEC-11-D2BA
PDP-15	MAINDEC-15-D2CA

APPENDIX B
SUGGESTED PROGRAMS FOR ALTERNATE ONES AND ZEROS TEST TAPES

The following is a list of ONES and ZEROS Tape Test programs.

	Address	Mnemonic	Octal			
PDP-8, 8I, 8L,	0200	CMA	7040			
PDP-12, 8E	0201	PLS	6026			
	0202	PSF	6021			
	0203	JMP-1	5202			
	0204	JMP 200	5200			
PDP-11	200	012737	177777	177556	MOV	#177777, @#177556
	206	105737	177554		TSTB	@#177554
	212	100375			BPL	.-4
	214	012737	000000	177556	MOV	#0, @#177556
	222	105737	177554		TSTB	@177554
	226	100375			BPL	.-4
	230	000137	000200		JMP	START
PDP-9, 15	0/	CLA	750000			
	1/	PSA	700204			
	2/	PSF	700201			
	3/	JMP-1	600002			
	4/	CMA	740001			
	5/	JMP-4	600001			

APPENDIX C
STALL PROGRAMS

Stall programs for the PC04/PC05 are listed below.

Suggested 5-ms Stall Program

Multiple Character
(Switch reg = N, Number of characters to read)

	Add		Mnemonic		Octal
PDP-8E, 8I, 8L, 12	200	Start	CLL CLA		7300
	201		LAS		7604
	202		CIA		7041
	203		DCA 220		3220
	204		TAD 217		1217
	205		DCA 221		3221
	206	A	CLL CLA		7300
	207		RRB RFC		6016
	210		RSF		6011
	211		JMP -.1		5210
	212		ISZ 220		2220
	213		JMP A	READ N Char.	5206
	214		ISZ -.1	STALL (5-15 ms)	2221
	215		JMP -.1		5214
	216		JMP START		5200
	217		0	(10 ms)	0000

	Address	Mnemonic	Octal	
PDP-9 and	0200	LAS	750004	
PDP-15	0201	AND MSK1	500221	
	0202	CMA	740001	
	0203	DAC COUNT	040217	Read
	0204	RSA	700104	16
	0205	RSF	700101	Lines
	0206	JMP.-1	600205	
	0207	ISZ COUNT	440217	
	0210	JMP READ	600204	
	0211	LAS	750004	
	0212	AND MSK2	500222	
	0213	DAC PAUSE	040220	Stall
	0214	ISZ PAUSE	440220	Between
	0215	JMP.-1	600214	Groups
	0216	JMP BEGIN	600200	

Count 0217 0
Pause 0220 0
MSK1 0221 000777
MSK2 0222 777000

AC SWITCHES = 600017 (Bits 0 to 8 determine stall time. Bits 9 to 17 = number of characters -1 to be read between stalls.)

PDP-11 Read "N" Characters
And Stall 5 ms Program

(Set SR = N, Number of bits to read)

	Address	Octal		Mnemonic	
PDP-11	200	013703	177570	Read:	MOV SR, %3
	204	105237	177550		INCB PRS
	210	105737	177550		TSTB PRS
	214	100375			BPL .-4
	216	005303			DEC %3
	220	001371			BNR .-12
	222	012704	003000	Stall:	MOV 3000, %4
	226	005304			DEC %4
	230	100376			BPL .-2
	232	000137	000200		JMP READ

APPENDIX D
SUMMARY SET-UP PROCEDURE

The following is a summary set-up procedure:

Step	Procedure
1	Feed wheel and motor adjusted correctly (5.3.4).
2	Tape depressor aligned correctly (5.3.5).
3	Tape Hold Down Bracket set for three tape thicknesses (5.3.6).
4	Lamps, lens, and light pattern adjusted properly (5.3.7).
5	Full speed running rate set for 3.33 ms/character (5.3.8).
6	Acceleration and stop delay within tolerances (5.3.9).
7	Threshold set midway between pickup and drop out errors (5.3.10).
8	Skew greater than 0.1 ms (5.3.10).

Digital Equipment Corporation
Maynard, Massachusetts

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